FOREST RESEARCH NOTES

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA FOREST AND RANGE
EXPERIMENT STATION

STEPHEN N. WYCKOFF, Director

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No. 48

January 1946

FORAGE SPECIES TESTED FOR MORE EXTENSIVE RESEEDING TRIALS ON CENTRAL CALIFORNIA RANGE LANDS

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Many forage species have been tested in Madera County during the process of selecting a few that are most promising for range reseeding. The purpose of this report is to summarize the results obtained to date with the various species and to indicate which warrant more extensive trials. Although this information has direct application only to the "granite area" of the Sierra Nevada foothills, it should be generally useful in areas of more favorable growing conditions in other parts of central California.

The tests have been of two kinds:

1. Tests in weeded nursery rows in the forage plant nursery at the San Joaquin Experimental Range in Madera County to observe the climatic adaptation and growth characteristics of different species and to eliminate from further testing those which have no promise.

2. Tests in small plots on different range sites to observe the establishment and survival of promising species. Some of the plots were located at the Experimental Range and others on ranches of cooperators under the supervision of E. L. Garthwaite, Madera County Farm Advisor.

Seeds for testing have been generously furnished by the Bureau of Plant Industry, Soils, and Agricultural Engineering, and the Soil Conservation Service of the United States Department of Agriculture; the California Agricultural Extension Service and the Division of Agronomy of the University of California; the commonwealth of Australia; and by other organizations and individuals.

Climate

The nursery and plots at the San Joaquin Experimental Range are located in the lower foothills at an elevation of 1,000 feet. The average seasonal precipitation has been 22.15 inches for the 10-year period of the tests, about 4 inches above the estimated long-time average, and has varied from 32.09 inches in 1937-38 to 12.25 inches in 1938-39. It occurs as rain during an approximate 6-month season from late fall to midspring. The winters are relatively mild, although frosts are frequent. Minimum temperatures near 25° F. have been recorded for several consecutive days each winter. The lowest temperature that has been recorded since the Station was established in 1935 is 17° F. The summers are long and hot, with maximum temperatures often near 105° F. for several days, the highest recorded being 115° F.

The plots on ranches of cooperators were located from the lower to the upper foothills. Some were at an elevation of about 2,500 feet, where moisture and soil conditions are more favorable, the average seasonal precipitation being approximately 30 inches and the dry season being 1 or 2 months shorter. The winters, however, are colder, and some snow occurs each year.

Tests

Nursery rows. The nursery soil is deeper than the average arable soil in the foothills and much deeper than the rough land. It is a favorable site for most of the species being tested, but it is too well drained for a few that require some subirrigation. Most species were tested on both a good sandy clay loam topsoil and a poor sandy soil mixture. Most species were seeded during both fall and late winter and during two or more different seasons. The rows were weeded sufficiently to keep down competing vegetation.

Notes were made on establishment of seedlings, longevity, drought resistance, winter hardiness, height, vigor, and seed production. From these notes results were classified as good, fair, and poor for each species. Observations were also made of the forage characteristics, such as leafiness or coarseness and season of growth of the plants.

The tabulation of results includes 184 species and strains tested in the nursery from 1935 through 1945. Several strains of some species were tested, but the results from individual strains are included only when they were significantly different from those reported for the species. A superior strain of one of the species, Bromus cathartícus, recently obtained from the University of California, has been added to the nursery tests and shows promise of being much more successful than the strain included in this report.

Range plots. The tests outside the nursery rows included broadcast plots, seeded rows, and transplant rows on several different kinds of sites with different methods of seedbed preparation. Of the 184 species and strains tested in the nursery rows, 54 were included in the range plots. Only a few small plots were successful, but a considerable amount of information was obtained on the promise of the various species for establishment and survival on different kinds of foothill ranges.

The results so far obtained from range plots are not considered conclusive. More extensive trials are needed to test the conditions to which each species is best adapted with larger plots and with more attention given to methods of seedbed preparation, seeding, and management of the seeded stands.

Recommendations

The recommendations are based largely on results obtained in these nursery and plot tests. Many of the species have also been tested in central California by the California Agricultural Extension Service, the Division of Agronomy of the University of California, and the United States Soil Conservation Service, and by interested individuals. Somewhat similar results have been reported from these trials and were considered in making the recommendations.

Extensive field trial. The 18 species recommended for extensive field trials are those that were outstanding in the nursery and showed good promise in at least some of the range plots. They should be tested on as many different sites as possible until the particular adaptation of each species is well known. Several different kinds of plants are included — native and introduced, perennial and annual, grass and broadleaf, and winter-growing and winter-dormant. Probably few, if any, species will have general application over all the central California valley and foothill range sites. Some may not prove adapted for any range use, and others will have only limited adaptability.

More research information is needed before any of the species can be recommended for use in other than experimental seedings. In the more extensive field trials now under way by this Station, all these 18 species are included as well as a few additional species that have been suggested by other workers.

Limited field trial. Most of the 40 species recommended for limited field trial fall into two groups:

The first includes 13 species, most of which are commonly used for reseeding under favorable moisture conditions. The work so far indicates that their best possibilities in central California are in areas of fairly high precipitation in the upper foothills and mountains or on subirrigated lands, and they should be given further trials on such lands. Some are being tried in experimental seedings at lower elevations. These 13 species are indicated by the note "favorable moisture" under the recommendation for limited field trials.

The second group includes 27 species which now seem to be of only fair promise but which require more field testing before conclusions can be drawn. Only two of these species are included in the extensive field tests now being conducted by this Station. Some of the others will be added if seed supplies are available.

More nursery trial. Most of the 17 species recommended for more nursery study fall into two groups:

The first includes shrubby plants that have grown well in the nursery. Several of them have shown some promise in range plots. More information is needed on means of obtaining successful germination and establishment before these species are recommended for field trial. More work is warranted because of the need for palatable shrubby species on California ranges.

The second includes species which are native to regions with summer rainfall but which have been successful in nursery rows under no summer rain. More information is needed on seed production and germination as well as growth of these species under competition before they can be recommended for field trial. Additional work with these species is of very low priority.

No more trial. No more work is recommended for 111 of the species. These include species that grew poorly and about half of the species that grew with only fair success in the weeded nursery rows. A few species of poor forage value that grew well in the nursery are also not considered worthy of more study.

Species tested, results, and recommendation for future trial

Species tested	Results: Nursery rows	Results: Range plots [1]	Recommendation
Acacia aneura, Mulga acacia (shrub)	Poor	-	No more trial
Agropyron cristatum, crested wheatgrass (perennial grass)	Good	Fair	Limited field trial
Agropyron parishii var. laeve, Parish wheatgrass (per. grass)	Poor	-	No more trial
Agropyron pauciflorum, slender wheatgrass (perennial grass)	Poor	-	" " "
Agrostis spica-venti, wind bentgrass (annual grass	Poor	-	" " "
Agrostis oregonensis, Oregon bentgrass (perennial grass)	Poor	-	" " "
Agrostis verticillata, water bentgrass (perennial grass)	Poor	-	" " "
Agrostis palustris, creeping bentgrass (perennial grass)	Poor	-	" " "
Alopecurus pratensis, meadow foxtail (perennial grass)	Poor	-	" " "
Alopecurus ventricosus, creeping foxtail (perennial grass)	Poor	-	" " "
Andropogon furcatus, big bluestem (perennial grass)	Fair	-	" " "
Andropogon saccharoides, silver bluestem (perennial grass)	Poor	-	" " "

[1] Entries are made in this column only for species that were given field trials. All species that were outstanding in the nursery have been included in field trials. A few species rated as good in the nursery were not included in field trials; enough information was obtained from their performance in the nursery to make recommendations for further testing. For several reasons, including the availability of seed, few species that were rated as only fair in the nursery were included in field trials.

Bouteloua eriopoda, black grama (perennial grass)	Poor	-	No more trial
Bouteloua filiformis, slender grama (perennial grass)	Poor	-	" " "
Bouteloua gracilis, blue grama (perennial grass)	Good	Fair	More nursery trial
Bouteloua hirsuta, hairy grama (perennial grass)	Poor	-	No more trial
Bouteloua parryi, Parry grama (annual grass)	Poor	-	" " "
Bouteloua rothrocki, Rothrock grama (perennial grass)	Poor	-	" " "
Brachypodium phoenicoides	Poor	-	" " "
Brachypodium pinnatum, Japanese falsebrome	Poor	-	" " "
Bromus carinatus, mountain brome (perennial grass)	Good	Fair	Limited field trial (favorable moisture)
Bromus catharticus, rescue brome (perennial grass)	Poor	-	No more trial (See p. 2)
Bromus inermis, smooth brome (perennial grass)	Good	-	Limited field trial (favorable moisture)
Bromus secalinus, chess brome (annual grass)	Poor	-	No more trial
Buchloe dactyloides, buffalo grass (perennial grass)	Fair	-	" " "
Cajanus cajan, pigeonpea (shrub)	Poor	-	" " "
Calamagrostis angustifolia	Poor	-	" " "
Chloris berroi, Argentine chloris	Poor	-	" " "
Chloris gayana, Rhodesgrass (perennial grass)	Poor	-	" " "
Cytisus proliferus (shrub)	Good	Fair	More nursery trial
Dactylis glomerata, orchard grass (perennial grass)	Fair	Fair	Limited field trial (favorable moisture)
Danthonia californica, California danthonia (perennial grass)	Fair	-	Limited field trial

Deschampsia caespitosa, tufted hairgrass (perennial grass)	Fair	-	No more trial
Digitaria eriantha, wooly fingergrass	Poor	-	" " "
Digitaria henryi	Poor	-	" " "
Digitaria marginata	Poor	-	" " "
Digitaria pentzi, Pentz fingergrass	Poor	-	" " "
Elymus canadensis, Canada wildrye (perennial grass)	Poor	-	" " "
Elymus condensatus, giant wildrye (perennial grass)	Good	-	" " "
Elymus dahuricus, Dahurian wildrye	Poor	-	" " "
Elymus glaucus, blue wildrye (perennial grass)	Good	Good	Extensive field trial
Elymus triticoides, creeping wildrye	Poor	-	No more trial
Eragrostis sp., Wilman lovegrass	Poor	-	" " "
Eragrostis curvula, weeping lovegrass (perennial grass)	Good	Good	Extensive field trial
Eragrostis lehmanniana, Lehmann lovegrass (perennial grass)	Fair	Fair	Limited field trial
Eragrostis orcuttiana, Orcutt lovegrass (annual grass)	Fair	-	No more trial
Eriogonum wrighti, Wright eriogonum (perennial weed)	Good	-	" " "
Erodium sebaceum (annual weed)	Fair	-	" " "
Erodium botrys, big heronbill "broadleaf filaree" (annual weed)	Good	-	" " "
Erodium cicutarium, alfileria "redstem filaree" (annual weed)	Fair	-	Limited field trial
Erodium moschatum, musk heronbill "whitestem filaree" (annual weed)	Fair	-	" " "
Erharta calycina, perennial veldt grass (perennial grass)	Good	Good	Extensive field trial
Eurotia lanata, common winterfat (perennial)	Good	-	More nursery trial

Fallugia paradoxa, apacheplume (shrub)	Poor	-	No more trial
Festuca elatior, meadow fescue (perennial grass)	Fair	-	" " "
Festuca elatior arundinacea, alta fescue (perennial grass)	Good	Good	Extensive field trial
Festuca ovina, sheep fescue (perennial grass)	Poor	-	No more trial
Festuca rubra, red fescue (perennial grass)	Poor	-	" " "
Gaijera parviflora, wilga	Poor	-	" " "
Hedysarum coronarium, Sulla sweetvetch (perennial weed)	Poor	-	" " "
Hierochloe occidentalis, California sweetgrass (perennial grass)	Poor	-	" " "
Hilaria belangeri, curlymesquite (perennial grass)	Poor	-	" " "
Hilaria jamesi, galleta (perennial grass)	Good	-	More nursery study
Hilaria mutica, tobosa (perennial grass)	Poor	-	No more trial
Hilaria rigida, big galleta (perennial grass)	Poor	-	" " "
Holcus lanatus, common velvetgrass (perennial grass)	Poor	Fair	Limited field trial (favorable moisture)
Hyparrhenia rufa, Jaragua	Poor	-	No more trial
Koeleria gracilis	Poor	-	" " "
Leptochloa dubia, green sprangletop (perennial grass)	Poor	-	" " "
Lespedeza stipulacea, Korean lespedeza (annual weed)	Poor	Poor	" " "
Lolium multiflorum, Italian ryegrass "domestic ryegrass" (annual grass)	Good	Good	Extensive field trials
Lolium perenne, perennial ryegrass (perennial grass)	Fair	Fair	Limited field trial (favorable moisture)
Lolium rigidum strictum, Wimmera	Good	Good	Extensive field trial

Lolium subulatum, Dalmation ryegrass (annual grass)	Good	Good	Extensive field trial
Lolium woldicum, Westerwolth (annual grass)	Good	Good	" " "
Lotus corniculatus, birdsfoot deervetch, "b. trefoil" (perennial weed)	Fair	Fair	Limited field trial (favorable moisture)
Lotus uliginosus, wetland deervetch (perennial weed)	Fair	-	Limited field trial (favorable moisture)
Lupinus albus, white lupine (annual weed)	Fair	-	More nursery study
Lupinus luteus, European yellow lupine (annual weed)	Fair	-	" " "
Medicago apiculata (annual weed)	Good	Fair	Limited field trial
Medicago arabica, spotted medic "Spotted burclover" (annual weed)	Fair	Fair	" " "
Medicago blancheana (annual weed)	Poor	-	No more trial
Medicago circinnata (annual weed)	Poor	-	" " "
Medicago coronata (annual weed)	Poor	-	" " "
Medicago disciformis (annual weed)	Fair	-	" " "
Medicago echinus, calvary medic (annual weed)	Good	-	Limited field trial
Medicago hispida, California burclover (annual weed)	Good	Good	Extensive field trial
Medicago hispida sardoa (annual weed)	Fair	-	Limited field trial
Medicago laciniata (annual weed)	Poor	-	No more trial
Medicago litoralis (annual weed)	Fair	-	" " "
Medicago murex (annual weed)	Fair	-	" " "
Medicago murex sorrentini (annual weed)	Poor	-	" " "
Medicago muricata (annual weed)	Good	-	Limited field trial
Medicago helix (annual weed)	Good	-	" " "
Medicago orbicularis, button medic	Fair	-	No more trial
Medicago rigidula, Tifton medic (annual weed)	Good	-	Limited field trial

Medicago rotata (annual weed)	Good	-	Limited field trial
Medicago sativa, common alfalfa "Chilean" (perennial weed)	Good	Fair	Limited field trial (favorable moisture)
Medicago sativa, ladak alfalfa (perennial weed)	Good	Fair	Limited field trial (favorable moisture)
Medicago scutellata, snail medic (annual weed)	Good	Fair	Limited field trial
Medicago soleirolii (annual weed)	Poor	-	No more trial
Medicago tuberculata, cogwheel medic	Good	-	Limited field trial
Medicago turbinata (annual weed)	Good	-	" " "
Medicago sp., creeping-rooted alfalfa (perennial weed)	Good	Fair	More nursery trial
Melica californica, California melic (perennial grass)	Good	Poor	Limited field trial
Melica bulbosa, oniongrass (perennial grass)	Good	Poor	" " "
Melica imperfecta, Coastrange melic (perennial grass)	Fair	Poor	" " "
Melica torreyana, Torrey melic (perennial grass)	Fair	-	No more trial
Melica subulata, Alaska oniongrass (perennial grass)	Poor	-	" " "
Melilotus alba, white sweetclover (biennial weed)	Good	Good	Limited field trial (favorable moisture)
Melilotus alba annua, hubam clover (annual weed)	Good	Good	Extensive trial
Melilotus indica, annual yellow sweetclover	Good	Fair	No more trial
Melilotus officinalis, yellow sweetclover	Good	Good	Limited field trial (favorable moisture
Muhlenbergia porteri, bush muhly (perennial grass)	Poor	-	No more trial
Nolina microcarpa, sacahuista	Poor	-	" " "
Onobyrychis viciaefolia, common sainfoin (perennial weed)	Fair	-	" " "
Oryzopsis hymenoides, Indian ricegrass (perennial grass)	Fair	Poor	More nursery trial

Oryzopsis miliacea, smilograss, "San Diego grass" (perennial grass)	Good	Good	Extensive trial (uncertain germination)
Oxytropis tenella, Ruby crazyweed	Poor	-	No more trial
Panicum antiodotale, blue panicum "giant panic" (perennial grass)	Good	Good	Extensive trial
Panicum obtusum, vine-mesquite (perennial grass)	Good	-	More nursery study
Panicum texanum, Texas panicum (perennial grass)	Poor	-	No more trial
Paspalum dilatatum, Dallisgrass (perennial grass)	Poor	Fair	Limited field trial (favorable moisture)
Paspalum stramineum, san paspalum (perennial grass)	Poor	-	No more trial
Pentzia incana, Australian sheepbush "Karroo bush" (shrub)	Good	-	More nursery trial
Pentzia virgata (shrub)	Good	-	" " "
Phalaris tuberosa var. stenoptera, Harding grass (perennial grass)	Good	Good	Extensive trial
Plantago fastigiata, desert Indian-wheat (annual weed)	Poor	-	No more trial
Poa bulbosa, bulbous bluegrass (perennial grass)	Fair	Fair	Limited field trial
Poa pratensis, Kentucky bluegrass (perennial grass)	Poor	-	No more trial
Poa scabrella, pine bluegrass (perennial grass)	Fair	Poor	" " "
Poa subfastigiata	Poor	-	" " "
Prosopis glandulosa, honey mesquite (shrub)	Good	-	" " "
Psoralea bituminosa, Arabian scurfpea (shrub)	Good	Fair	Limited field trial
Puccinellia tenuiflora	Poor	-	No more trial
Sanguisorba minor, small burnet (perennial weed)	Good	Good	Extensive field trial
Secale? (note determined), Michels' hybrid rye (partly perennial grass)	Fair	Good	Limited field trial

Simmondsia chinensis, California jojoba (shrub)	Poor	Poor	No more trial
Sitanion jubatum, big squirreltail (perennial grass)	Good	-	" " "
Sporobolus airoides, alkali sacaton (perennial grass)	Fair	-	Limited field trial (alkali soils)
Sporobolus flexuosis, mesa dropseed (perennial grass)	Poor	-	No more trial
Sporobolus giganteus, giant dropseed (perennial grass)	Good	-	" " "
Stipa cernua, nodding needlegrass "nodding stipa" (perennial grass)	Good	Good	Extensive trial
Stipa coronata, crested needlegrass (perennial grass)	Fair	-	No more trial
Stipa lepida, foothill needlegrass (perennial grass)	Good	-	Limited field trial
Stipa papposa (perennial grass	Good	Fair	No more trial
Stipa pulchra, California needlegrass "purple stipa" (perennial grass)	Good	Good	Extensive trial
Stipa speciosa, desert needlegrass (perennial grass)	Poor	-	No more trial
Stipa splendens, cheegrass	Poor	-	" " "
Stipa viridula, green needlegrass (perennial grass)	Poor	-	" " "
Trifolium carolinianum, Carolina clover (perennial weed)	Poor	-	" " "
Trifolium dubium, suckling clover (annual weed)	Poor	-	" " "
Trifolium fragiferum, strawberry clover (perennial weed)	Poor	-	" " "
Trifolium glomeratum, cluster clover (annual weed	Poor	-	" " "
Trifolium procumbens, low hop (annual weed)	Poor	-	" " "
Trifolium resupinatum, Persian clover (annual weed)	Poor	-	" " "

rifolium subterraneum, subterranean clover, early varieties (annual weed)	Fair	Poor	Limited field trial
subterraneum, subterranean clover, mid-season varieties (annual weed)	Good	Good	Extensive field trial
subterraneum, subterranean clover, late varieties (annual weed)	Fair	Fair	Limited field trial
richachne californica, Arizona cotton-top (perennial grass)	Poor	-	No more trial
rigonella foenum-graecum, fenugreek trigonella (annual weed)	Good	-	" " "
cia atropurpurea, purple vetch (annual weed)	Good	Fair	Limited field trial
cia pulchella, sweetclover vetch	Poor	-	No more trial
cia villosa, hairy vetch (annual weed)	Fair	Good	Extensive field trial